

A revision of the genus *Pseudovorticella* Foissner & Schiffmann, 1974 (Ciliophora: Peritrichida)

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Introduction

The genus *Pseudovorticella* was erected by Foissner & Schiffmann (1974) to include those peritrichs which are morphologically similar to *Vorticella* but which have a reticulate silver line system with lines running vertically as well as horizontally. The reticulate pattern of silver lines underlies a system of pellicular tubercles which covers the entire zooid surface except the disc and infundibulum.

Pellicular tubercles have been studied by several workers over the past century. Schröder (1906) showed that the tubercles of *Pseudovorticella monilata* are surface features, the distribution of which corresponds to that of the underlying striations. Ultrastructural studies by TEM (Kawamura, 1973) and SEM (Carey & Warren, 1983) have confirmed this observation. Kawamura (1973) also showed that each tubercle of *P. monilata* is a semisphere, about 2.0 µm in diameter, and contains a sphere of electron dense material. Further investigations using histochemical staining (Fauré-Fremiet & Thureauux, 1944; Pratt & Rosen, 1983) and microanalysis (Pratt & Rosen, 1983) indicate that the tubercles contain paraglycogen. The function of the tubercles is not known although it has been suggested that they may aid predator avoidance (Spoon, 1975).

Foissner & Schiffmann (1974) noted that the silver line system is particularly useful for species diagnosis in *Pseudovorticella*, and biometric analyses have been carried out on several species (Foissner & Schiffmann, 1974 & 1975; Foissner, 1979). Parameters which are of particular taxonomic value include the total number of silver lines per zooid and dimensions of the grids formed by the intersecting vertical and horizontal lines. Morphological features traditionally used in vorticellid taxonomy are also useful diagnostic characters for the species of *Pseudovorticella*; these include the size and shape of the zooid, the number and position(s) of the contractile vacuole(s) and the shape and position of the macronucleus (Noland & Finley, 1931; Foissner, 1979; Warren, 1986).

Sixteen species of *Pseudovorticella* are recognised, twelve of which originally belonged to the genus *Vorticella*. A key to their identification is provided.

Systematics

In the scheme adopted by the Committee on Systematics and Evolution of the Society of Protozoologists (Levine *et al.*, 1980), the taxonomic position of the genus *Pseudovorticella* was given as follows:

Phylum:	Ciliophora Doflein, 1901
Class:	Oligohymenophora de Puytorac <i>et al.</i> , 1974
Subclass:	Peritrichia Stein, 1859
Order:	Peritrichida Stein, 1859
Suborder:	Sessilina Kahl, 1933
Family:	Vorticellidae Ehrenberg, 1838
Genus:	<i>Pseudovorticella</i> Foissner & Schiffmann, 1974

Diagnosis

Solitary bell-shaped zooids borne upon a spirally contractile stalk. In all respects save one, the body and stalk of *Pseudovorticella* resemble those of *Vorticella* from which it cannot be differentiated until impregnated with silver, which reveals a reticulate silver line pattern quite unlike that of *Vorticella* (see Warren, 1986). In addition to *Vorticella* this genus could be mistaken for *Haplocaulis* in which the stalk contracts in a zigzag rather than a helical manner.

Key to the species of *Pseudovorticella*

1	With endosymbiotic zoochlorellae	2
—	Without endosymbiotic zoochlorellae	3
2	Zooid about 40 µm long; macronucleus C-shaped	<i>P. zooanthelligera</i> (Fig. 9b)
—	Zooid 75–95 µm long; macronucleus J-shaped	<i>P. chlorelligera</i> (Fig. 1a)
3	Diameter of peristomial lip less than or equal to maximum body width	4
—	Diameter of peristomial lip greater than maximum body width	10
4	Diameter of peristomial lip less than maximum body width	5
—	Diameter of peristomial lip equal to maximum body width	6
5	Macronucleus J-shaped	<i>P. difficilis</i> (Fig. 1 c & d)
—	Macronucleus C-shaped	<i>P. papillata</i> (Fig. 5c)
6	Body length less than × 2 maximum body width	7
—	Body length at least × 2 maximum body width	<i>P. micata</i> (Fig. 2b)
7	One contractile vacuole	8
—	Two contractile vacuoles	<i>P. sphagni</i> (Fig. 7b)
8	Macronucleus lies vertical with respect to major axis of zooid	9
—	Macronucleus lies horizontal with respect to major axis of zooid	<i>P. stilleri</i> (Fig. 9a)
9	Zooid 65–80 µm long and with 44–54 transverse striations	<i>P. quadrata</i> (Fig. 7a)
—	Zooid 35–45 µm long and with 20–33 transverse striations	<i>P. sawwaldensis</i> (Fig. 8)
10	Zooid with two contractile vacuoles	11
—	Zooid with one contractile vacuole	13
11	Zooid with centrally located constriction; scopular region rounded	<i>P. margaritata</i> (Fig. 2a)
—	Zooid without centrally located constriction; scopular region tapers towards stalk	12
12	Zooid 40–45 µm long; stalk length × 16–18 zooid length	<i>P. mollis</i> (Fig. 3a)
—	Zooid 60–70 µm long; stalk × 3 zooid length	<i>P. monilata</i> (Fig. 3b, c & d)
13	Diameter of peristomial lip less than body length	14
—	Diameter of peristomial lip greater than body length	<i>P. punctata</i> (Fig. 6)
14	Zooid less than × 3 maximum body width	15
—	Zooid length greater than × 3 maximum body width	<i>P. mutans</i> (Fig. 4 c & d)
15	Zooid 50–70 µm long × 22–48 µm wide; typically marine	<i>P. nebulifera</i> (Fig. 4 a & b)
—	Zooid 32–50 µm long × 20 µm wide; typically freshwater	<i>P. pseudocampanula</i> (Fig. 5 a & b)

Description of Species

P. chlorelligera (Kahl, 1935) Jankowski, 1976

V. margaritata f. *chlorelligera* Kahl, 1935

P. margaritata f. *chlorelligera* (Kahl, 1935) Foissner & Schiffmann, 1975

DIAGNOSIS (Fig. 1a & b). Zooid inverted bell-shaped, 78–95 µm long × 50 µm wide; peristomial lip 80 µm diameter; infundibulum reaches half body length; macronucleus J-shaped; numerous endosymbiotic zoochlorellae present in cytoplasm; zooid has a total of 33–53 (mean 47.7) transverse striations; grid size

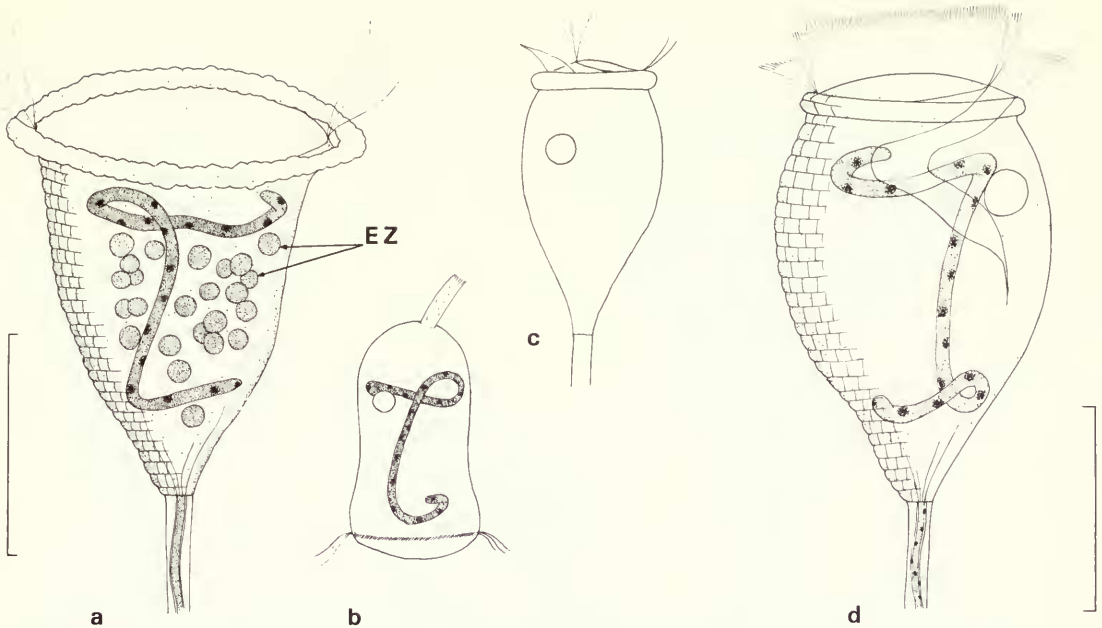


Fig. 1. (a) *P. chlorelligera* zooid, bar = 50 μm ; (b) telotroch, bar = 25 μm (after Foissner & Schiffmann, 1975); (c) *P. difficilis* (after Kahl, 1935); (d) *P. difficilis*, bar = 50 μm (after Foissner & Schiffmann, 1975; called *P. difficilis* var. *magnistriata*).

1.3–3.2 $\mu\text{m} \times 2.0$ –4.5 μm ; zooid surface with 15–28 (mean 22) pellicular pores per 100 μm^2 ; telotroch nearly cylindrical in shape and with a prominent epistomial membrane (Fig. 1b).

HABITAT. Freshwater.

P. difficilis (Kahl, 1933) Jankowski, 1976

V. difficilis Kahl, 1933

P. difficilis var. *magnistriata* Foissner & Schiffmann, 1974

DIAGNOSIS (Fig. 1c & d). Zooid 60–140 μm long \times 40–70 μm wide; diameter of peristomial lip less than maximum body width; infundibulum reaches half body length; single contractile vacuole situated in upper part of zooid close to infundibulum; macronucleus J-shaped; 39–49 (mean 43.9) transverse striations per zooid; grid size 3.1–4.7 $\mu\text{m} \times 2.7$ –3.4 μm ; spasmoneme with numerous thecoplastic granules.

HABITAT. Freshwater or marine.

P. margaritata (Fromentel, 1874) Jankowski, 1976

DIAGNOSIS (Fig. 2a). Zooid inverted bell-shaped, 59–70 μm long \times 50 μm wide, with a slight constriction in the central region and rounded at the scopular end; peristomial lip 70 μm in diameter; two contractile vacuoles situated in anterior part of zooid; macronucleus C-shaped and situated in centre of zooid.

HABITAT. Freshwater, particularly eutrophic lakes and stagnant water.

REMARKS. This species has been redescribed by Kahl (1935) and Stiller (1971).

P. micata (Kahl, 1933) nov. comb.

V. micata Kahl, 1933

DIAGNOSIS (Fig. 2b). Zooid elongate, 65 μm long \times 25 μm wide; peristomial lip 25 μm in diameter; disc flat and slightly elevated above peristome; infundibulum reaches one third zooid length; contractile vacuole situated in upper part of zooid close to infundibulum.

HABITAT. Marine.

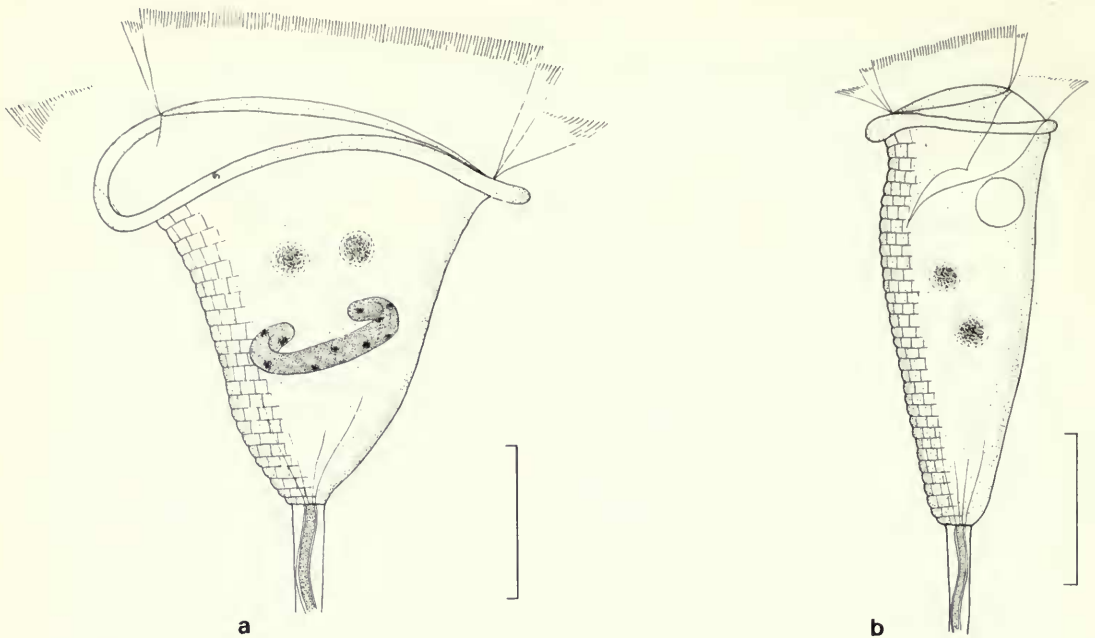


Fig. 2. (a) *P. margaritata*, bar = 25 μ m (composite from Kahl, 1935 and Stiller, 1971); (b) *P. micata*, bar = 25 μ m (after Kahl, 1935).

P. mollis (Stokes, 1887) nov. comb.

V. mollis Stokes, 1887

DIAGNOSIS (Fig. 3a). Zooid inverted bell-shaped, 40–45 μ m long \times 25 μ m wide; peristomial lip 40 μ m in diameter; infundibulum reaches one third body length; two contractile vacuoles situated in anterior part of zooid; stalk \times 16–18 zooid length.

HABITAT. Freshwater

REMARKS. Although this species was not drawn by Stokes (1887), it has been observed and figured by Nenninger (1948).

P. monilata (Tatem, 1870) Foissner & Schiffmann, 1974

V. lockwoodii Stokes 1884

V. monilata Tatem, 1870

DIAGNOSIS (Fig. 3b, c & d). Zooid inverted bell-shaped, 45–70 μ m long \times 40–45 μ m wide; peristomial lip 50 μ m in diameter; infundibulum reaches half body length; two contractile vacuoles situated in anterior part of zooid; macronucleus J-shaped; 31–41 (mean 35.3) transverse striations per zooid; grid size 2.5–3.5 μ m \times 1.5–2.5 μ m; stalk \times 3 body length; spasmoneme with thecoplasmic granules; telotroch cone-shaped with prominent epistomial membrane.

HABITAT. Freshwater, often forming pseudocolonies; Pratt & Rosen (1983) reported large numbers of *Pseudovorticella* (*Vorticella*) *monilata* attached the Cyanobacterium *Anabaena flos-aquae*.

P. mutans (Penard, 1922) Foissner, 1979

V. mutans Penard, 1922

DIAGNOSIS (Fig. 4c & d). Zooid inverted bell-shaped, 65–95 μ m long \times 18–25 μ m wide; peristomial lip 25 μ m in diameter; disc convex; infundibulum reaches half body length; contractile vacuole situated in upper half of body close to infundibulum; macronucleus J-shaped; zooid has 40–47 (mean 43) transverse striations; grid

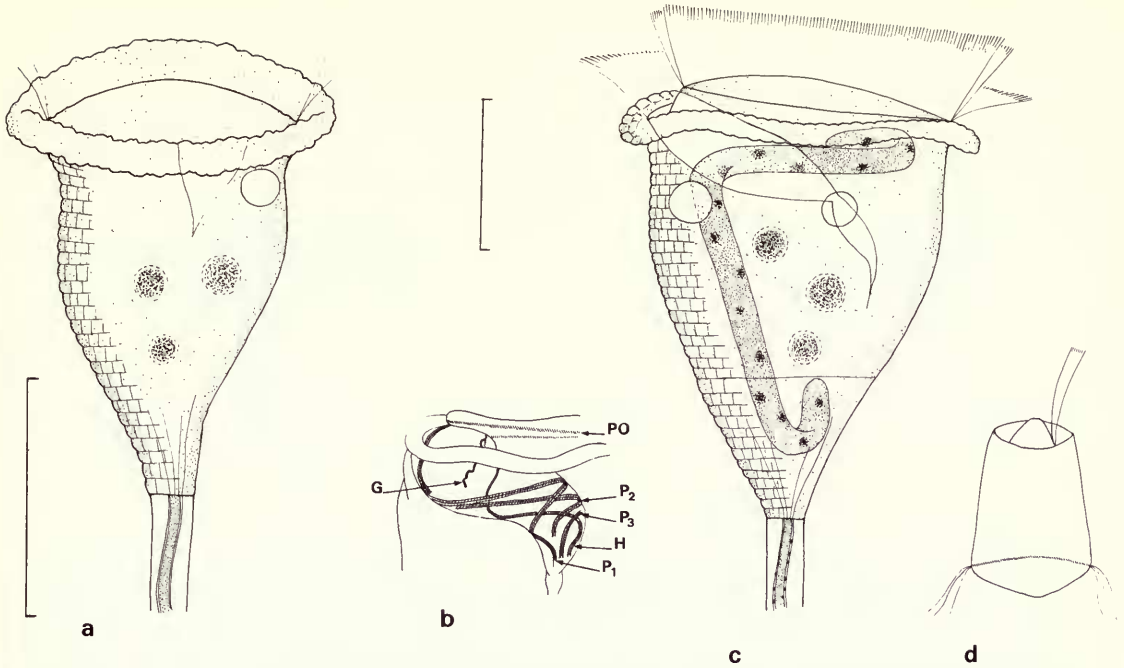


Fig. 3. (a) *P. mollis*, bar = 25 μ m (after Nenninger, 1948); (b) *P. monilata* showing oral ciliation (detail from Pätsch, 1974); (c) zooid, bar = 25 μ m; (d) telotroch (after Foissner, 1979). G = germinal kinety; H = haplokinety; P₁, P₂, P₃ = 1, 2, 3, peniculus; PO = polykinety.

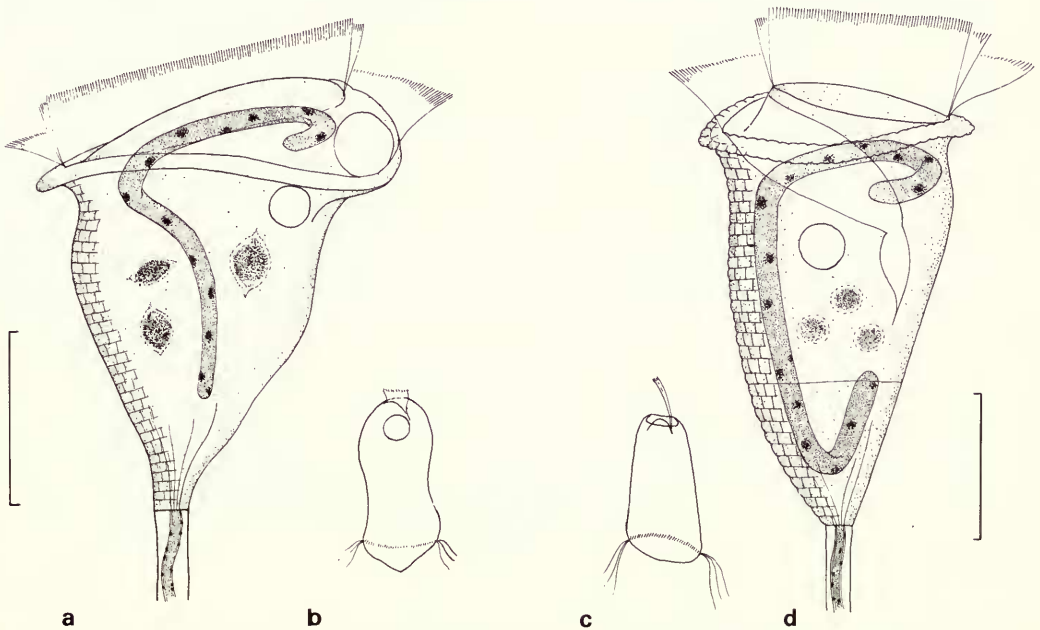


Fig. 4. (a) *P. nebulifera* zooid, bar = 25 μ m (after Noland & Finley, 1931); (b) telotroch (after Barlow & Finley, 1976b); (c) *P. mutans* telotroch; (d) zooid, bar = 25 μ m (after Foissner, 1979).

size $1.4\text{--}1.5\ \mu\text{m} \times 1.5\text{--}2.2\ \mu\text{m}$; stalk $\times 5$ body length and $8.0\ \mu\text{m}$ wide; spasmoneme with thecoplastic granules; telotroch with prominent epistomial membrane.

HABITAT. Freshwater.

P. nebulifera (Müller, 1786) Jankowski, 1976

V. nebulifera Müller, 1786

DIAGNOSIS (Fig. 4a & b). Zooid inverted bell-shaped, $38\text{--}78\ \mu\text{m}$ (mean $60\ \mu\text{m}$) long $\times 22\text{--}48\ \mu\text{m}$ (mean $37\ \mu\text{m}$) wide; slightly constricted beneath peristomial lip which measures $32\text{--}66\ \mu\text{m}$ (mean $53\ \mu\text{m}$) in diameter; single contractile vacuole situated close to infundibulum; macronucleus J-shaped; stalk $50\text{--}800\ \mu\text{m}$ (mean $150\ \mu\text{m}$) long $\times 3.5\text{--}6.0\ \mu\text{m}$ (mean $4.7\ \mu\text{m}$) wide; spasmoneme with thecoplastic granules; telotroch $47\text{--}75\ \mu\text{m}$ (mean $60\ \mu\text{m}$) long; cyst $37\ \mu\text{m}$ in diameter.

HABITAT. Marine or freshwater.

REMARKS. Redescribed by Noland & Finley (1931); for telotroch and SEM studies, see Barlow & Finley (1976a & b).

P. papillata (Stiller) Jankowski, 1976

V. microstoma f. *monilata* Stiller (see Stiller, 1971)

DIAGNOSIS (Fig. 5c). Zooid $35\text{--}80\ \mu\text{m}$ (mean $55\ \mu\text{m}$) long $\times 22\text{--}50\ \mu\text{m}$ (mean $35\ \mu\text{m}$) wide, the maximum body width being the mid region of the zooid; peristomial lip $12\text{--}25\ \mu\text{m}$ (mean $23\ \mu\text{m}$) in diameter; disc convex; infundibulum reaches one third body length; contractile vacuole situated in anterior part of zooid; macronucleus C-shaped and lies longitudinally with respect to major axis of zooid.

HABITAT. Freshwater, particularly under conditions of high biochemical oxygen demand (BOD_5).

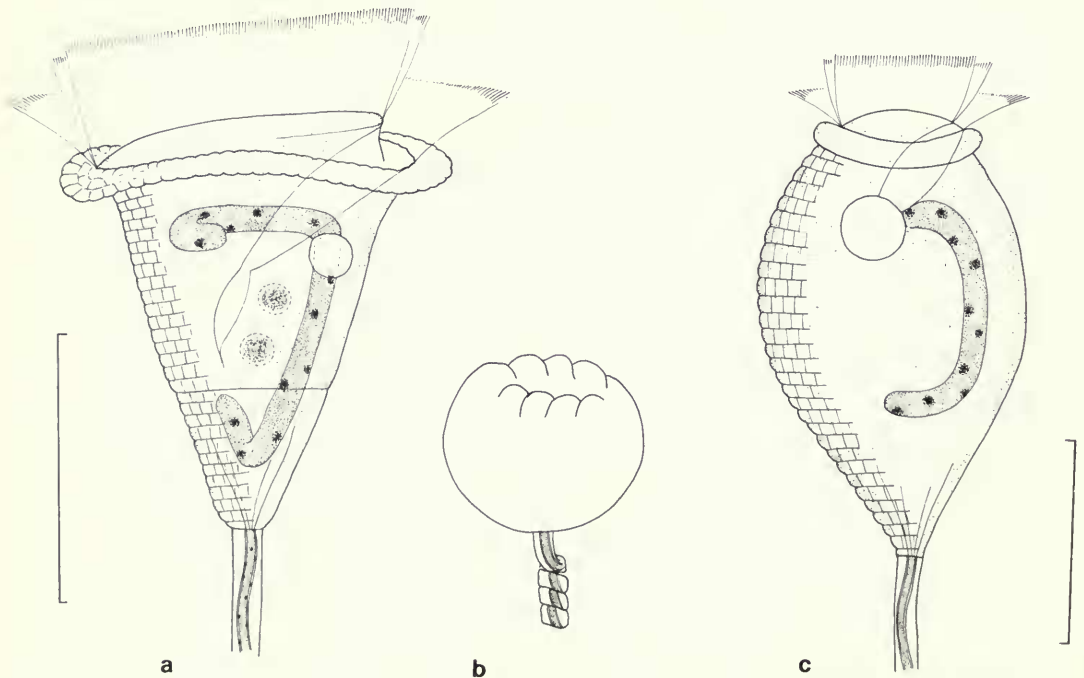


Fig. 5. (a) *P. pseudocampanula* relaxed zooid, bar = $25\ \mu\text{m}$; (b) contracted zooid (after Foissner, 1979); (c) *P. papillata*, bar = $25\ \mu\text{m}$ (after Stiller, 1971).

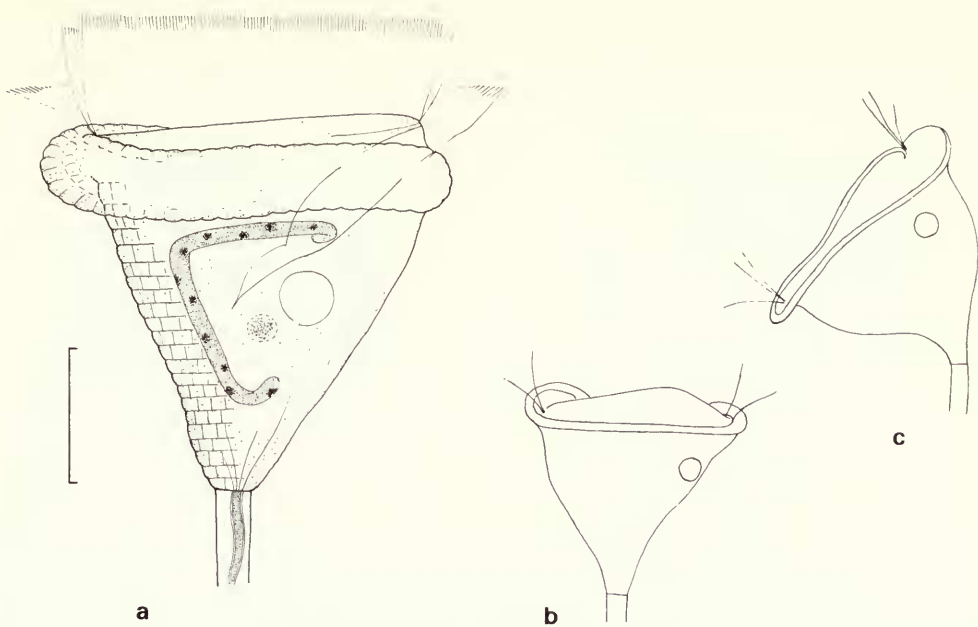


Fig. 6. *P. punctata*, (a) bar = 25 μm (after Dons, 1918); (b) after Stiller (1946) (called *Vorticella subconica*); (c) after Kahl (1935) (called *Vorticella perlata*).

P. pseudocampanula Foissner, 1979

DIAGNOSIS (Fig. 5a & b). Zooid conical/inverted bell-shaped, 32–50 μm (mean 40 μm) long \times 20 μm wide; peristomial lip 35 μm in diameter; upon contraction, peristomial lip becomes puckered (Fig. 5b); infundibulum reaches half body length; contractile vacuole situated close to infundibulum; macronucleus J-shaped; zooid has 44–51 (mean 46.6) transverse striations; grid size 1.3–2.6 μm \times 1.5–3.0 μm ; stalk \times 7 body length; thecoplasmic granules present on spasmoneme.

HABITAT. Freshwater.

P. punctata (Dons 1918) nov. comb.

V. punctata Dons, 1918

V. subconica Stiller, 1946

P. subconica (Stiller, 1946) Jankowski, 1976

DIAGNOSIS (Fig. 6). Zooid conical or inverted bell-shaped, 40–50 μm long \times 40 μm wide; peristomial lip 50–55 μm in diameter; disc convex; infundibulum reaches one third body length; contractile vacuole situated in upper part of zooid; macronucleus J-shaped; stalk \times 4–5 body length and 4.0 μm wide.

HABITAT. Marine.

P. quadrata Foissner, 1979

DIAGNOSIS (Fig. 7a). Zooid 65–80 μm (mean 70 μm) long \times 55 μm wide; peristomial lip 60 μm in diameter; infundibulum reaches half body length; contractile vacuole situated in anterior part of zooid; macronucleus J-shaped; zooid has 44–54 (mean 48.3) transverse striations; grid size 1.5–2.8 μm \times 1.3 \times 2.7 μm ; stalk \times 7 body length and 9.0 μm wide; spasmoneme with thecoplasmic granules.

HABITAT. Freshwater.

P. sauwaldensis Foissner & Schiffmann, 1979

DIAGNOSIS (Fig. 8). Zooid shape variable, usually inverted bell-shaped 35–45 μm long \times 20 μm wide; peristomial lip 20 μm in diameter and 3.0 μm thick; disc convex; infundibulum reaches half body length;

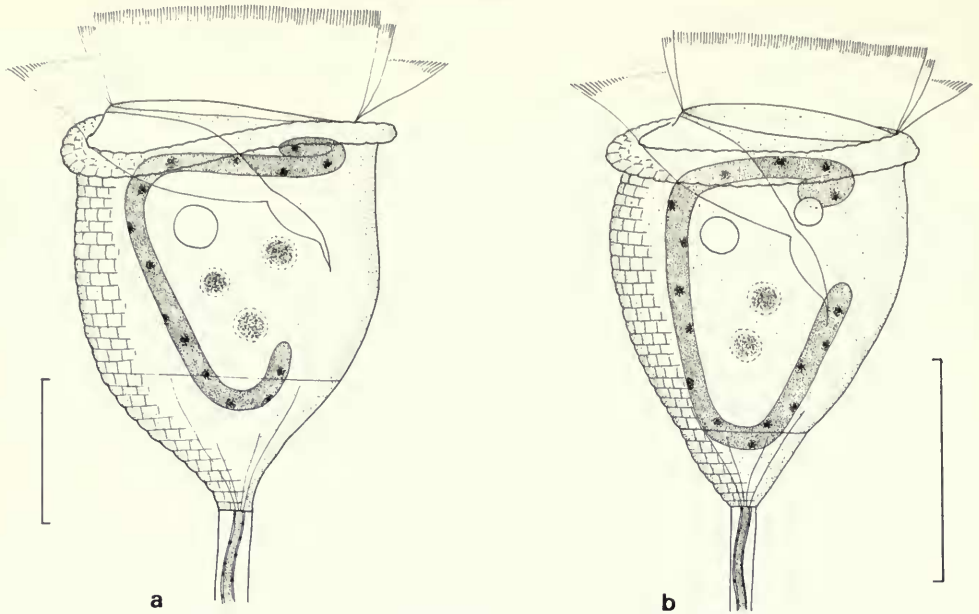


Fig. 7. (a) *P. quadrata*, bar = 25 μ m; (b) *P. sphagni*, bar = 25 μ m (after Foissner, 1979).

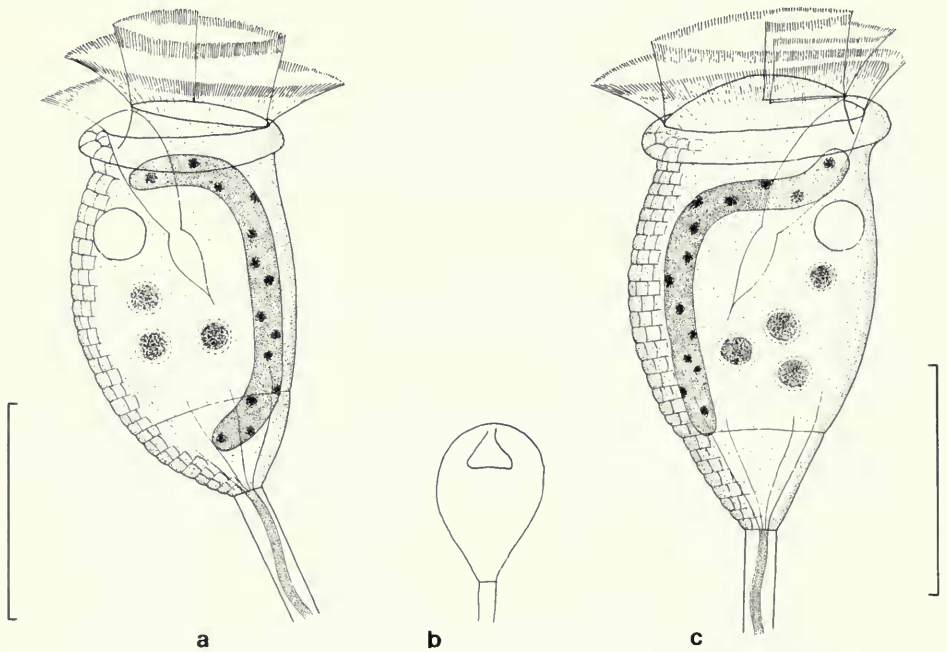


Fig. 8. *P. sawwaldensis* (a) normal zooid, bar = 20 μ m; (b) contracted zooid; (c) showing variability of macronucleus and zooid shape, bar = 20 μ m (after Foissner & Schiffmann, 1979).

contractile vacuole situated in upper part of zooid close to infundibulum; macronucleus vermiform, variable in shape and situated longitudinally with respect to major body axis; pellicle has 20–33 (mean 29) transverse striations; grid size 0.9–1.5 μ m \times 0.7–2.5 μ m; stalk \times 1–3 body length.

HABITAT. Freshwater.

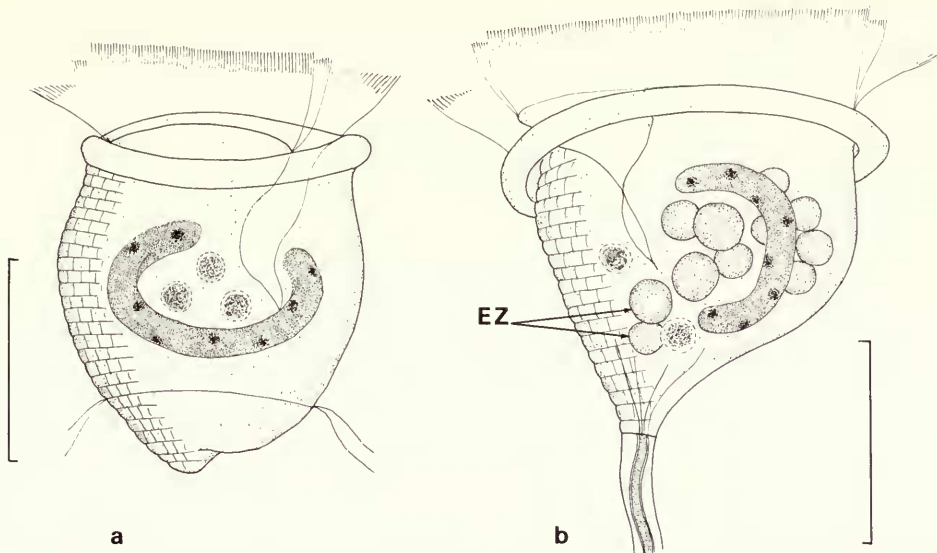


Fig. 9. (a) *P. stilleri*, bar = 50 μm (after Stiller, 1963); (b) *P. zooanthelligera*, bar = 25 μm (after Stiller, 1968). EZ = endosymbiotic zoochlorellae.

P. sphagni Foissner, 1979

DIAGNOSIS (Fig. 7b). Zooid inverted bell-shaped, 40–50 μm long \times 30 μm wide; peristomial lip 30 μm in diameter; infundibulum reaches one third body length; two contractile vacuoles situated in anterior part of zooid; macronucleus J-shaped with elongate distal arm; zooid has 34–37 (mean 35.5) transverse striations; grid size 1.6–1.9 μm \times 2.5–2.7 μm .

HABITAT. Freshwater, originally isolated from *Sphagnum* bogs.

P. stilleri n. sp.

V. campanula f. *monilata* Stiller, 1963

DIAGNOSIS (Fig. 9a). Zooid inverted bell-shaped, 85 μm long \times 80 μm wide; peristomial lip 80 μm in diameter; infundibulum reaches half body length; macronucleus C-shaped and lies horizontally across centre of zooid.

HABITAT. Freshwater, attached to the duckweed *Lemna minor*.

P. zooanthelligera (Stiller, 1968) nov. comb.

V. zooanthelligera Stiller, 1968

DIAGNOSIS (Fig. 9b). Zooid inverted bell-shaped, 40–42 μm long \times 40 μm wide; peristomial lip 50 μm in diameter; disc flat; infundibulum reaches one third body length; macronucleus C-shaped and lies longitudinally in zooid; cytoplasm contains numerous endosymbiotic zoochlorellae; stalk \times 5 body length.

HABITAT. Freshwater.

Incertae sedis

Pseudovorticella sp. (Graham & Graham, 1978) nov. comb.

Vorticella sp. Graham & Graham, 1978

Graham & Graham (1978) made an ultrastructural study of a vorticellid (*Vorticella* sp.) furnished with pellicular tubercles and containing endosymbiotic zoochlorellae. The presence of pellicular tubercles suggests

that this organism should belong to the genus *Pseudovorticella*. However other important diagnostic features, for example the macronucleus, contractile vacuole(s) and shape of the relaxed zooid, were not recorded. Only when such data is available will it be possible to determine the exact status of this organism.

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References

- Barlow, B. M. & Finley, H. E. 1976a. Comparative studies on four species of *Vorticella* by scanning electron microscopy. *Transactions of the American Microscopical Society* **95**: 352–356.
- & — 1976b. Comparative studies on four species of *Vorticella* by conventional microscopy. *Transactions of the American Microscopical Society* **95**: 346–351.
- Carey, P. G. & Warren, A. 1983. The role of surface topography in the taxonomy of peritrich ciliates. *Protistologica* **19**: 73–99.
- Doflein, F. 1901. *Die Protozoen als Parasiten und Krankheitserreger, nach biologischen Gesichtspunkten dargestellt*. 274 pp. G. Fischer, Jena.
- Dons, C. 1918. Two new vorticellids. *Tromsø Museums Aarshafter* **40**: 1–18.
- Ehrenberg, C. G. 1838. *Die Infusionsthierchen als Vollkommene Organismen*. 612 pp. Leipzig.
- Fauré-Fremiet, E. & Thureaux, J. 1944. Les globules de 'paraglycogen' chez *Balantidium* et *Vorticella monilata*. *Bulletin de la Société Zoologique de France* **69**: 3–6.
- Foissner, W. 1979. Peritriche Ciliaten (Protozoa: Ciliaten) aus alpinen Kleingewässern. *Zoologische Jahrbücher (Systematik)* **106**: 529–558.
- & Schiffmann, H. 1974. Vergleichende Studien an argyrophilen Strukturen von vierzehn peritrichen Ciliaten. *Protistologica* **10**: 489–508.
- & — 1975. Biometrische und morphologische Untersuchungen über die Variabilität von argyrophilen Strukturen bei peritrichen Ciliaten. *Protistologica* **11**: 415–428.
- & — 1979. Morphologie und Silberliniensystem von *Pseudovorticella sawwaldensis* nov. spec. und *Scyphidia physarum* Lachmann, 1856 (Ciliophora, Peritrichida). *Berichte der Naturwissenschaftlich-Medizinischen Vereinigung in Salzburg* **3–4**: 83–94.
- Fromentel, E. de 1874–1876. *Etudes sur les Microzoaires ou Infusoires Proprement Dits, Comprendent de Nouvelles Reserches sur Leur Organisation, Leur Classification, et de la Description des Espèces Nouvelles ou Peu Connues*. 364 pp. G. Masson, Paris.
- Graham, L. E. & Graham, J. M. 1978. Ultrastructure of endosymbiotic *Chlorella* in a *Vorticella*. *Journal of Protozoology* **25**: 207–210.
- Jankowski, A. W. 1976. Revision of the order Sessilida (Peritricha). In *Material and Public Meeting of Protozoology I* pp. 168–170 Kiev [In Russian].
- Kawamura, R. 1973. The ciliary and fibrillar systems of the ciliate *Vorticella*. *Journal of Science of the Hiroshima University, Series B* **24**: 183–203.
- Kahl, A. 1933. Ciliata libera et ectocommensalia. In G. Grimpe & E. Wagler, eds, *Die Tierwelt der Nord- und Ostsee*, Lief. 23 (Tiel, II, c₃); Leipzig, pp. 147–183.
- 1935. Urtiere oder Protozoa. I: Wimpertiere oder Ciliata (Infusoria), einer Bearbeitung der freilebenden und ectocommensalen Infusorien der Erde, unter Ausschluss der marinen Tintinnidae. 4 Peritricha und Chonotricha. In G. Grimpe & E. Wagler eds., *Die Tierwelt Deutschlands*, Tiel **30**: 651–864.
- Levine, N. D., Corliss, J. O., Cox, F. E. G., Deroux, G., Grain, J., Honigberg, B. M., Leedale, G. F., Loeblich, A. R., Lom, J., Lynn, D., Merinfeld, E. G., Page, F. C., Poljansky, G., Sprague, V., Vavra, J. & Wallace, F. G. 1980. A newly revised classification of the Protozoa. *Journal of Protozoology* **27**: 37–58.
- Müller, O. F. 1876. *Animalcula Infusoria Fluvialia et Marina*. Havniae et Lipsiae. 367 pp.
- Nenninger, U. 1948. Die Peritrichen der Umgebung von Erlangen mit besonderer Berücksichtigung ihrer Wirtsspezifität. *Zoologische Jahrbücher (Systematik)* **77**: 169–266.
- Noland, L. E. & Finley, H. E. 1931. Studies on the taxonomy of the genus *Vorticella*. *Transactions of the American Microscopical Society* **50**: 81–125.
- Pätsch, B. 1974. Die Aufwuchsciliaten des Naturlehrparks haus Wildenrath. Monographische Bearbeitung der Morphologie und Ökologie. *Arbeiten aus dem Institut für Landwirtschaftliche Zoologie und Bienkunde* No. 1. 1–78.
- Penard, E. 1922. *Études sur les Infusoires d'Eau Douce*. 331 pp. George & Cie, Geneva.

- Pratt, J. R. & Rosen, B. H. 1983. Association of species of *Vorticella* (Peritrichida) and planktonic algae. *Transactions of the American Microscopical Society* 102: 48–54.
- Puytorac, P. de, Batisse, A., Bohatier, J., Corliss, J. O., Deroux, G., Didier, P., Dragesco, J., Fryd-Versavel, G., Grain, J., Grolière, C. A., Hovasse, R., Ifode, F., Laval, M., Roque, M., Savoie, A. & Tuffrau, M. 1974. Proposition d'une classification du phylum Ciliophora Doflein, 1901 (Réunion de Systematique, Clermont-Ferrand). *Compte Rendu Hebdomadaire des Séances de l'Académie des Sciences. Paris* 278: 2799–2802.
- Schröder, O. 1906. Beiträge zur Kenntnis von *Vorticella monilata* Tatem. *Archiv für Protistenkunde* 7: 395–410.
- Sondheim, M. 1929. Protozoen aus der Voeltzkowschen Reisen in Madagaskar und Ostafrika. *Abhandlungen hrsg. von der Senckenbergischen Naturforschenden Gesellschaft* 41: 285–313.
- Spoon, D. M. 1975. *Survey, Ecology and Systematics of the Upper Potomac Estuary Biota; Aufwuchs Microfauna, Phase I*. Final Report. Water Resources Center, Washington Technical Institute, Washington. 117 pp.
- Stein, F. 1859. *Der Organismus der Infusionsthier nach eingenen Forschungen in Systematischer Reihenfolge bearbeitet I*. 206 pp. Leipzig.
- Stiller, J. 1940. Beiträge zur Peritrichenfauna des Groben Plöner Sees in Holstein. *Archiv für Hydrobiologie* 38: 263–285.
- 1946. Beiträge zur Kenntnis der Peritrichenfauna der Adria bei Split. *Annales Historico-Naturales Musei Nationalis Hungarici* 39: 59–74.
- 1963. Zur Limnologie der Natrongewässer Ungarns. I Der Natronsee Nagyszék und seine Peritrichenfauna. *Internationale Revue der Gesamten Hydrobiologie und Hydrographie* 48: 603–612.
- 1968. Peritriche Ciliaten Okologisch verschiedener Biotop von Rovinj und Umgebung. *Acta Zoologica Academiae Scientiarum Hungaricae* 14: 185–211.
- 1971. Szájoszorús Csillósok—Peritricha. *Fauna Hungaricae* 105: 1–245.
- Stokes, A. C. 1883. A new vorticellid. *American Monthly Microscopical Journal* 4: 208.
- 1884. A new infusorien belonging to the genus *Vorticella*. *American Naturalist* 18: 829–830.
- 1887. Notices of new fresh water infusoria. *Proceedings of the American Philosophical Society* 24: 244–255.
- Tatem, J. G. 1870. A contribution to the teratology of the infusoria. *Monthly Microscopical Journal* 3: 194–195.
- Warren, A. 1986. A revision of the genus *Vorticella* (Ciliophora: Peritrichida). *Bulletin of the British Museum (Natural History)*. *Zoology Series* 50(1): 1–57.

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Index

Index of extant species; annotated list of nominal species.

- P. anabaenae* (Stiller, 1940) Jankowski, 1976 was transferred to the genus *Haplocaulis* by Stiller (1971).
- P. chlorelligera* (Kahl, 1935) Jankowski, 1976 2
- P. chlamyphora* (Penard, 1922) Jankowski, 1976 = *Vorticella vestita* Stokes, 1883 (see Warren, 1986).
- P. difficilis* (Kahl, 1933) Jankowski, 1976 3
- P. difficilis* var. *magnistriata* Foissner & Schiffmann, 1974 = *P. difficilis*.
- P. lima* (Kahl, 1935) Jankowski, 1976. This species appears to have pellicular granules rather than tubercles; it should therefore remain in the genus *Vorticella* (*V. lima*) until it has been redescribed.
- P. margaritata* (Fromentel, 1874) Jankowski, 1976 3
- P. micata* (Kahl, 1933) nov. comb. 3
- P. mollis* (Stokes, 1887) nov. comb. 4
- P. monilata* (Tatem, 1870) Foissner & Schiffmann, 1974 4
- P. mutans* (Penard, 1922) Jankowski, 1976 4
- P. nebulifera* (Müller, 1786) Jankowski, 1976 6
- P. papillata* (Stiller) Jankowski, 1976 6
- P. pelagica* (Gajewskaja, 1933) Jankowski, 1976 was transferred to the genus *Haplocaulis* by Stiller (1971).

- P. perlata* (Kahl, 1933) Jankowski, 1976 = *P. punctata*.
- P. plicata* (Gourret & Roeser, 1886) Jankowski, 1976 appears to be identical to *Vorticella elongata* Fromentel, 1874 (Warren, 1986).
- P. pseudocampanula* Foissner, 1979 7
- P. punctata* (Dons, 1918) nov. comb. 7
- P. quadrata* Foissner, 1979 7
- P. sauwaldensis* Foissner & Schiffmann, 1979 7
- P. sphagni* Foissner, 1979 9
- P. stilleri* (Stiller, 1963) n. sp. 9
- P. subconica* (Stiller, 1946) Jankowski, 1976 appears to be identical to *P. punctata*.
- P. vestita* (Stokes, 1883) Jankowski, 1976. A membranous alveolar covering overlays the pellicle of this species. There is, however, no evidence of pellicular tubercles or of an underlying reticulate pattern of silver lines. This species should therefore remain in the genus *Vorticella* (*V. vestita*) until it has been redescribed.
- P. voeltzkowi* (Sondheim, 1929) Jankowski, 1976. This species has spine-like projections on its pellicle. There is, however, no evidence that it has either pellicular tubercles or a reticulate pattern of silver lines. It should therefore remain in the genus *Vorticella* (*V. voeltzkowi*) until a redescription is available.
- P. zooanthelligera* (Stiller, 1968) nov. comb. 9